

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

STANDING STOCKS OF FISHES IN SECTIONS
OF INDIAN CREEK, PLUMAS COUNTY, 1979

By

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Bay-Delta Fishery Project
Contract Services Section
Information Report
80-1

September 1980

This report, which has been reviewed only by the Contract Services Supervisor, contains data that would not otherwise be available in a report format. The work was funded by the Department of Water Resources under W. A. 1600.

INTRODUCTION

In 1976, the Department of Water Resources (DWR) initiated an instream flow program. The purpose of this program is to identify streams that would benefit from flow enhancement, assess instream values and identify trade-offs required to enhance these streams. The Northern District of DWR selected Indian Creek below Antelope Reservoir (Figure 1) as one of the streams to study under this program. Initial flow studies by DWR indicated that flow augmentation could double trout habitat in the first 16 km of Indian Creek below the dam and increase habitat by 25% in lower reaches (Hinton, MS). As a result of this study, DWR and the Department of Fish and Game decided to reoperate Antelope Reservoir to increase flow releases to 0.6 cms year-round on a trial basis. These flows would be such that recreation at Antelope Reservoir would not be impaired.

The role of the Contract Services Section in this study is to monitor fish populations in selected sections of Indian Creek and assist DWR personnel in determining fishing effort and catch in the creek. This report describes sections of the creek we sampled, fish species we caught, and fish biomass at each station.

METHODS

Standing stocks of fishes were estimated at six stations in Indian Creek (Figure 1). Each station contained riffles and pools. Stations were selected to be near stations that had been sampled in previous studies. Markers were placed in trees along the stream to permanently establish station boundaries for future sampling. Each station was not necessarily

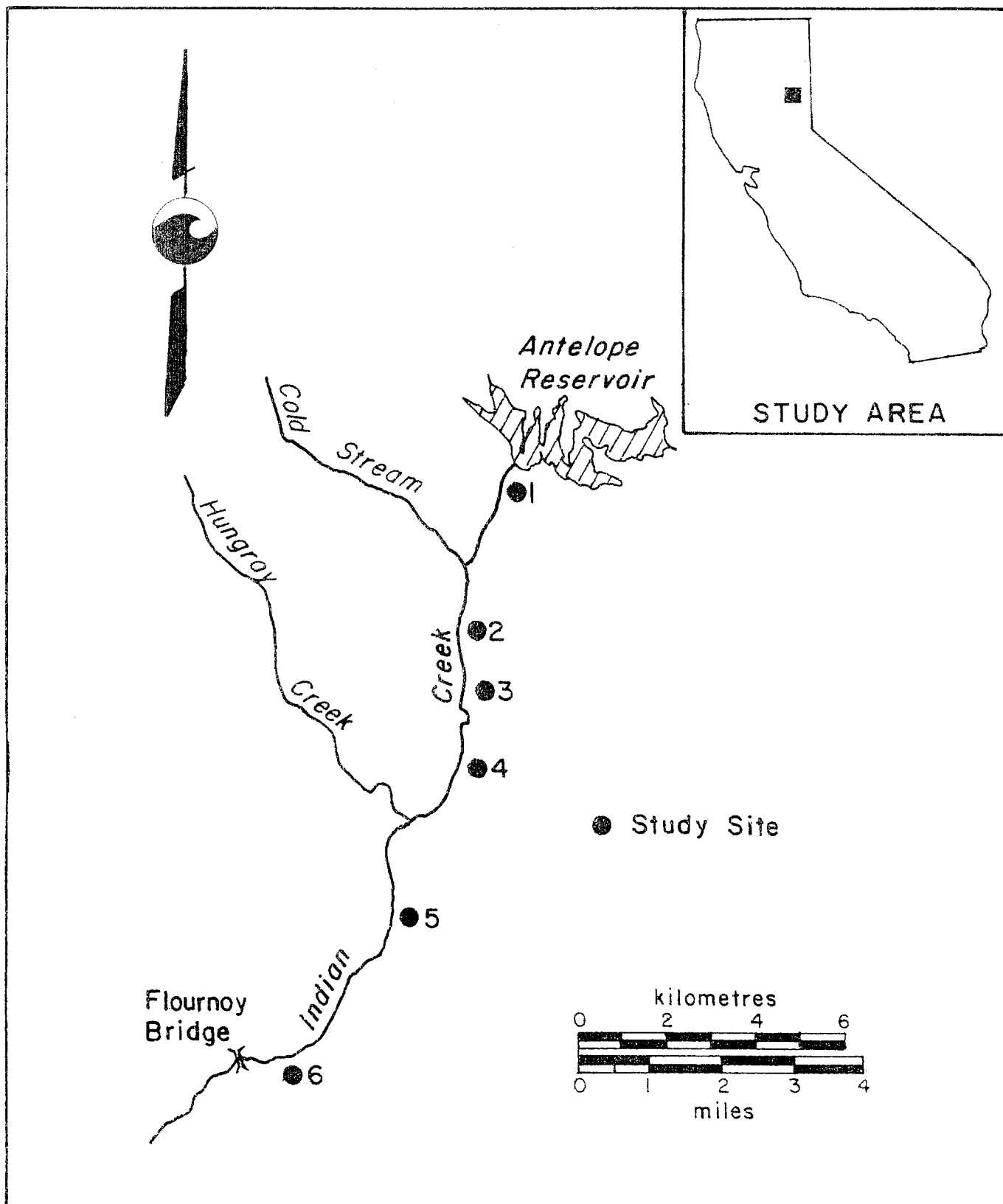


Figure 1 - Stations sampled to determine biomass of fishes in Indian Creek, Plumas County, September 1979.

representative of the stream reach in which it was located. Stations varied in length from 34 to 72 m. The length, average width, and average depth of each station was measured with a cloth tape. Fish were captured with a battery-powered backpack electroshocker in stream sections blocked by seines. Fish were removed from the net-enclosed section on each pass. Standing stock estimates were developed using the two-count method of Seber and LeCren (1967) or the multiple pass method of Leslie and Davis (1939) with limits of confidence computed using a formula proposed by DeLury (1951).

The weight of each fish was determined by displacement. Fork length of each fish was measured to the nearest millimetre.

Scales were mounted dry between microscope slides and their images were projected on a wall through a Bausch and Lomb microprojector at a magnification of 42X. Scale measurements for the calculation of growth were recorded to the nearest millimetre along the anterior radius of the anterior-posterior axis of the scale.

Geometric mean functional regressions were used to describe the body-scale and length-weight relationships (Ricker, 1975). Information on growth was developed using the von Bertalanffy growth function and a Walford graph (Walford, 1946). Estimation of true mean growth rate (G) was calculated using the methods of Ricker (1975).

RESULTS

Distribution

We caught brown trout (Salmo trutta), rainbow trout (Salmo gairdneri), Sacramento sucker (Catostomus occidentalis), and Sacramento squawfish (Ptychocheilus grandis) in Indian Creek. Brown trout were caught at every station. We observed rainbow trout throughout the creek, although we did not

catch them at each station. We caught Sacramento squawfish and Sacramento suckers only at the lowest section of the sampling area (Table 1).

Standing Crop

Brown trout were the most common game fish caught and biomass averaged 4.3 g/m^2 at six stations (Table 2). Rainbow trout averaged 2.0 g/m^2 in three stations (Table 3). Brown trout large enough to be kept by most fishermen (127 mm FL) averaged 2.2 g/m^2 in six stations and rainbow trout large enough to be kept averaged 2.9 g/m^2 in two stations.

Sacramento sucker was the most common non-salmonid fish caught. We calculated a biomass of 0.8 g/m^2 for our lowest station. Sacramento squawfish biomass was 0.1 g/m^2 in the same station. We did not catch non-salmonid fishes in other stations (Table 4).

Age and Growth

The formula $L = 17.44 + 1.316 S$ describes the relationship between the fork length (L) and enlarged scale radius (S) of 137 brown trout. The coefficient of correlation (r) is 0.85. The formula was $L = 17.57 + 1.483 S$ for 30 rainbow trout. The value for r is 0.89.

Growth as measured for the mean of individual growth rates was faster for age 1+ brown trout than for age 2+ fish. The population growth rate was faster for 2+ fish than for 1+ fish (Table 5). We did not catch enough rainbow trout to compute growth.

TABLE 1
DISTRIBUTION OF FISHES IN SECTIONS OF
INDIAN CREEK, PLUMAS COUNTY, 1979

	<u>Station Number</u>					
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Distance Below Antelope Dam (km)	0.6	3.9	5.3	6.8	12.3	21.0
Brown Trout	X	X	X	X	X	X
Rainbow Trout		X	X		X	X
Sacramento Squawfish						X
Sacramento Sucker						X

TABLE 2
ESTIMATES OF BROWN TROUT STANDING CROP IN
INDIAN CREEK, PLUMAS COUNTY, 1979

Distance Below Antelope Dam (km)	Population Estimate	95 Percent Confidence Interval	Biomass g/m ²	Estimate of Catchable Trout (≥ 127 mm FL)	Biomass of Catchable Trout g/m ²
0.6	28	27-30	1.2	1	1.1
3.9	149	143-156	4.5	11	1.9
5.3	188	178-198	7.9	18	4.1
6.8	253	226-278	9.9	10	3.0
12.3	93	81-105	2.0	6	0.9
21.0	2	2-2	0.1	0	0

TABLE 3
ESTIMATES OF RAINBOW TROUT STANDING CROP IN
INDIAN CREEK, PLUMAS COUNTY, 1979

Distance Below Antelope Dam (km)	Population Estimate	95 Percent Confidence Interval	Biomass g/m ²	Estimate of Catchable Trout (≥ 127 mm FL)	Biomass of Catchable Trout g/m ²
0.6	0	0	0	0	0
3.9	3 ^{1/}	-	-	0	0
5.3	1	1-1	0.3	0	0
6.8	0	0	0	0	0
12.3	20	17-22	0.6	7	0.6
21.0	8	7-9	5.2	8	5.2

^{1/} Actual catch

TABLE 4
ESTIMATES OF STANDING CROPS OF NONGAME FISHES
IN INDIAN CREEK, PLUMAS COUNTY, 1979

Distance Below Antelope Dam (km)	Species	Population Estimate	95 Percent Confidence Interval	Biomass g/m ²
0.6	--	-	-	-
3.9	--	-	-	-
5.3	--	-	-	-
6.8	--	-	-	-
12.3	--	-	-	-
21.0	Sacramento Sucker	20	10-30	0.8
21.0	Sacramento Squawfish	8	0-18	0.1

TABLE 5
GROWTH RATES FOR BROWN TROUT
CAUGHT IN INDIAN CREEK, 1979

Age Interval	Population Growth			Mean Individual Growth		
	Length Interval mm	Difference of Natural Logarithms	Instantaneous Growth Rate Gx	Length Interval mm	Difference of Natural Logarithms	Instantaneous Growth Rate G
1-2	106-173	0.489	1.398	103-173	0.518	1.558
2-3	173-311	0.586	1.674	229-311	0.306	1.205

The von Bertalanffy equation as estimated for the brown trout population is: $L_t = 1730 (L - e^{-0.057(t - 0.175)})$

where L_t = length at age t

We caught no brown trout older than 3+ years. Fish of this age averaged 360 mm in length, while 2+ fish averaged 259 mm, and 1+ fish averaged 181 mm (Table 6).

TABLE 6
CALCULATED FORK LENGTH IN MILLIMETRES
OF BROWN TROUT FROM INDIAN CREEK,
PLUMAS COUNTY, TAKEN IN SEPTEMBER 1979

Age	Number of Fish	Length at Capture	Calculated Lengths at Successive Annuli		
			1	2	3
1	119	181	106	-	-
2	10	259	105	173	-
3	8	360	115	229	311
Number of back-calculations			137	18	8
Weighted means			106	198	311
Increments			106	92	113

Length and Weight

Age group 0+ brown trout represented 93% of the catch, while 1+ fish made up 5%, 2+ fish comprised 1% and 3+ represented 1% (Figure 2). In contrast, age 0+ rainbow trout comprised 27% of the catch while age 1+ through 3+ fish made up 31, 38 and 4%, respectively (Figure 3).

The relationship between length (L) and weight (W) of brown trout is:

$$\log_{10} W = -4.620 + 2.854 \log_{10} L$$

$$r = 0.959$$

$$N = 153 \text{ (Figure 4)}$$

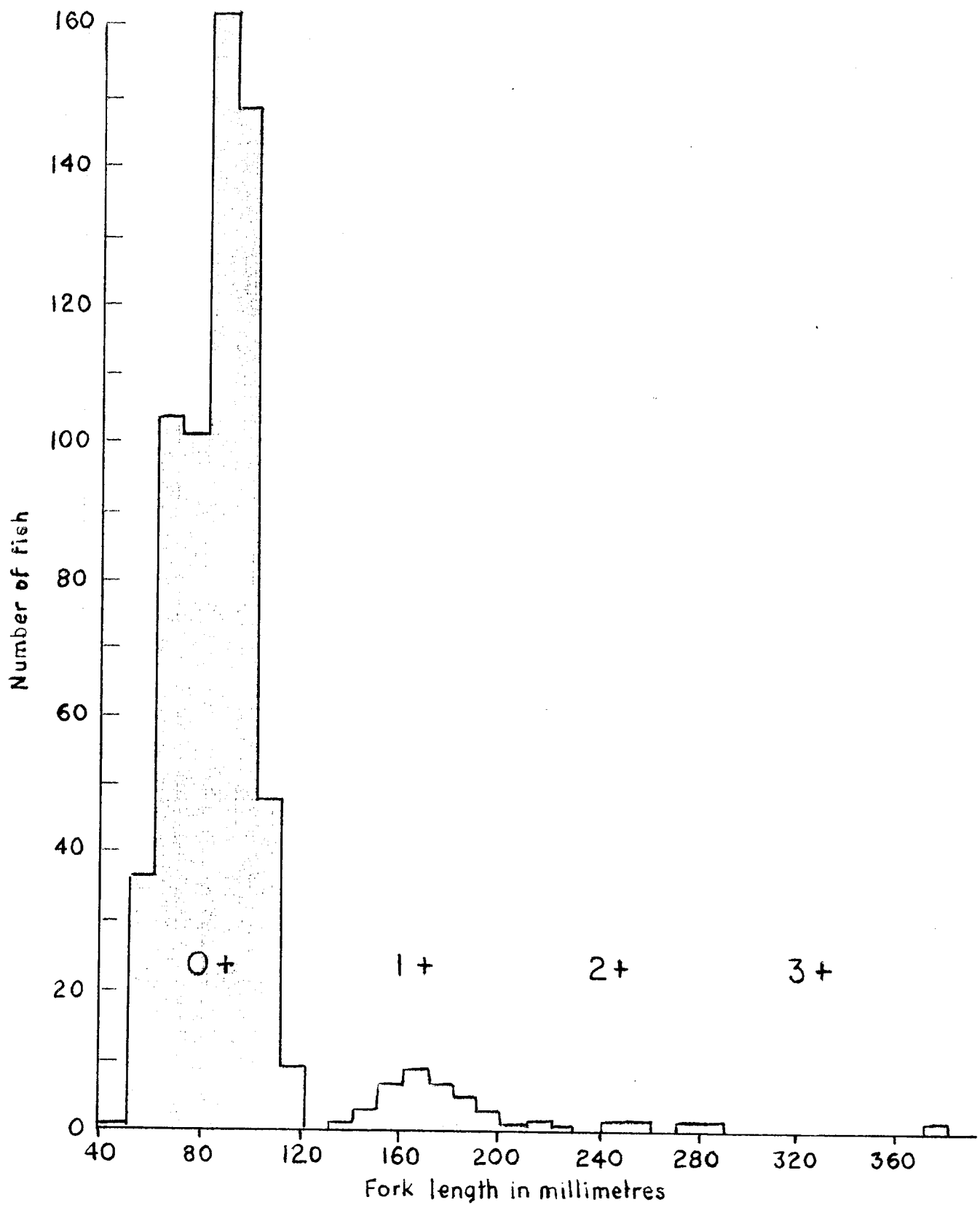


Figure 2- Length, frequency of occurrence, and age of brown trout caught in sections of Indian Creek, Plumas County, 1979.

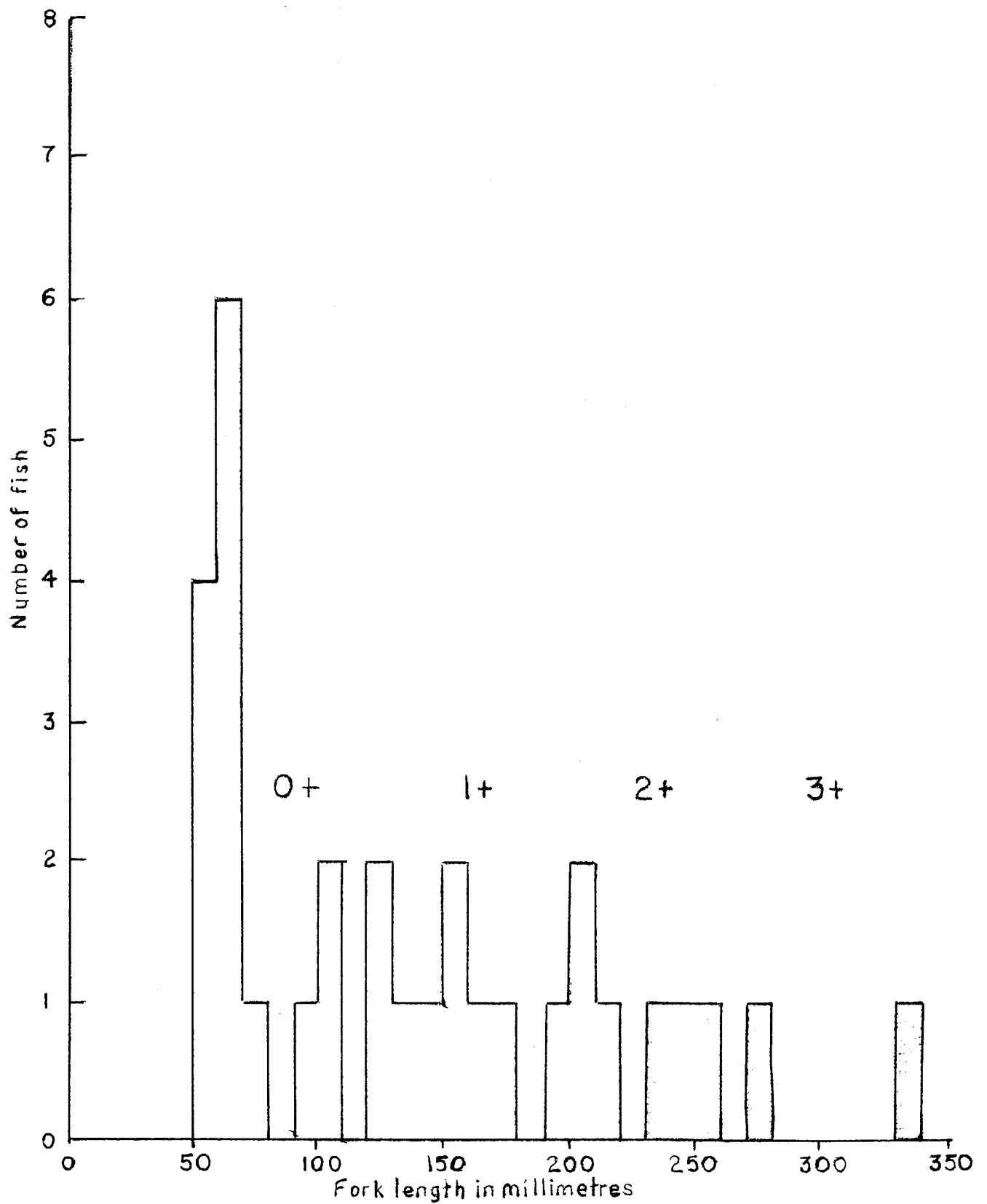


Figure 3 - Length, frequency of occurrence, and age of rainbow trout caught in sections of Indian Creek, Plumas County, 1979.

The same relationship for rainbow trout is:

$$\text{Log}_{10} W = -4.978 + 3.000 \text{Log}_{10} L$$

$$r = 0.992$$

$$N = 52 \text{ (Figure 5)}$$

Coefficient of Condition

We calculated the coefficient of condition and 95% confidence limits for 762 brown trout and 52 rainbow trout (Table 7).

There is no significant difference between the coefficient of condition for any age group of rainbow trout we tested ("+" test, 0.05 level). The coefficient of condition for age 1+ brown trout was significantly greater ("+" test, 0.05 level) than for 0+ fish, but there was no difference between 1+ brown trout and other age groups.

TABLE 7

CONDITION OF BROWN TROUT AND RAINBOW TROUT IN INDIAN CREEK, 1979

Age Group	Number of Fish	Coefficient of Condition	95% Confidence Limits
BROWN TROUT			
0+	609	1.065	+ .349
1+	126	1.123	+ .309
2+	15	1.067	+ .253
3+	12	1.098	+ .245
Combined	762	1.076	+ .344
RAINBOW TROUT			
0+	14	1.095	+ .311
1+	16	1.104	+ .433
2+	20	1.158	+ .284
3+	2	1.088	+ 1.164
Combined	52	1.094	+ .353

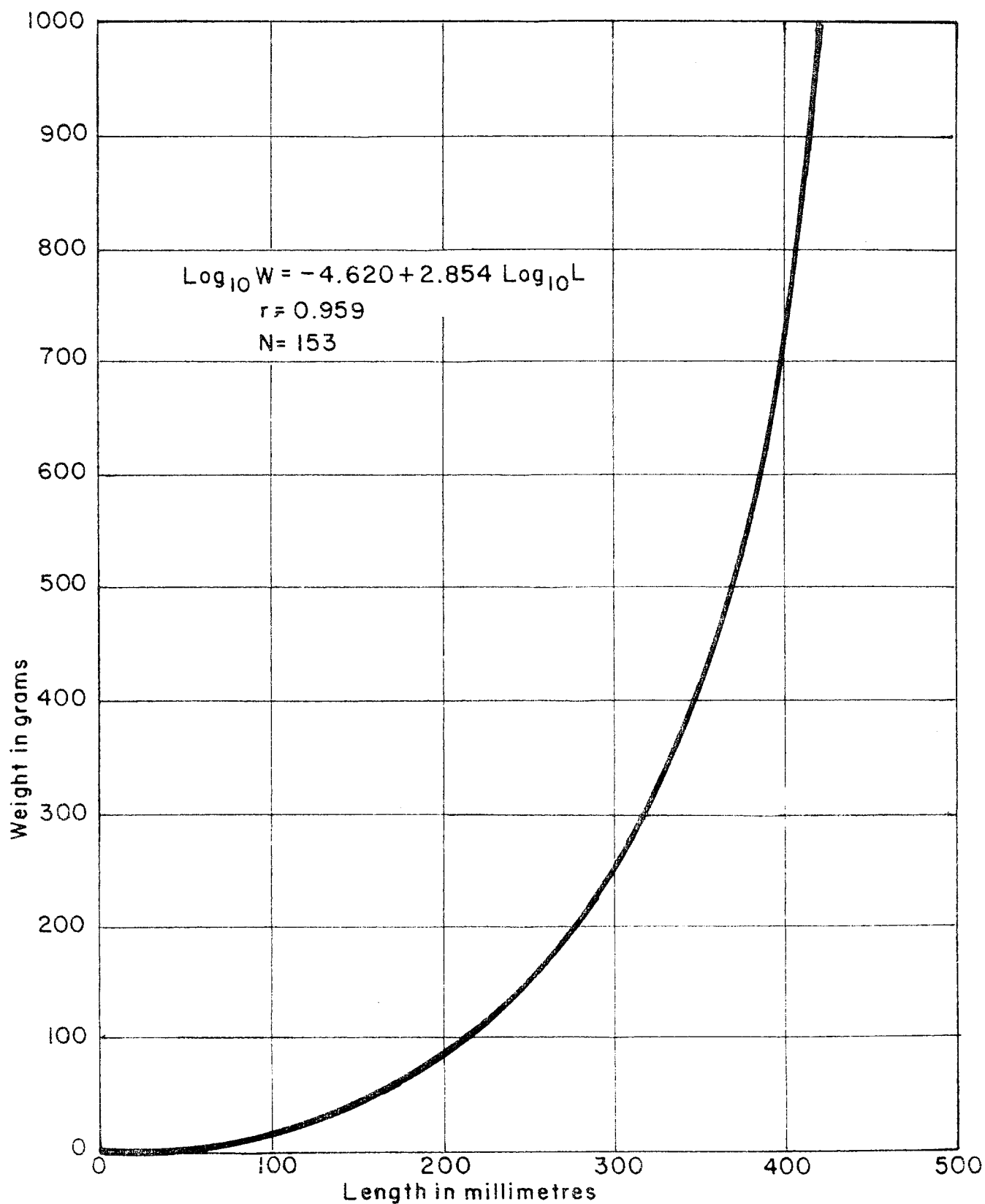


Figure 4 - The relationship between length and weight of brown trout caught in sections of Indian Creek, Plumas County.

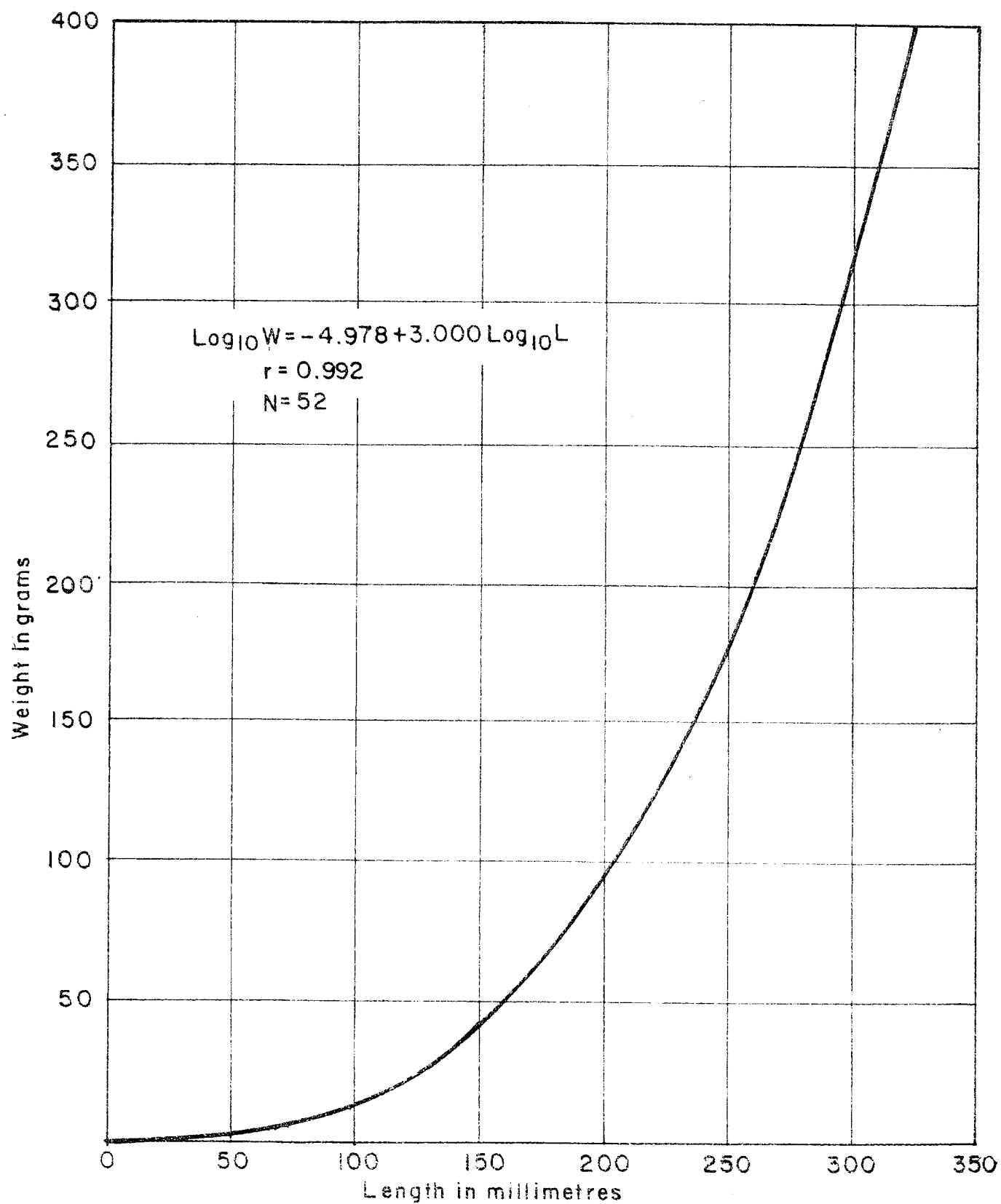


Figure 5 - The relationship between length and weight of rainbow trout caught in sections of Indian Creek, Plumas County.

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APPENDIX 1

PERMANENT FISH POPULATION STATIONS
INDIAN CREEK, PLUMAS COUNTY
SEPTEMBER 1979

APPENDIX I

PERMANENT FISH POPULATION STATIONS INDIAN CREEK, PLUMAS COUNTY SEPTEMBER 1979

Station 1 - Located 0.6 km below Antelope Dam adjacent to picnic area near junction of Indian Creek Road and spur road leading to base of dam (NE $\frac{1}{4}$ of NE $\frac{1}{4}$, Section 27, T27N, R12E). The station extends 23 m upstream and 23 m downstream from a 13-cm-diameter pine (LB). The station consists of a pool-run area (45%) between two riffles (55%). The station has a surface area of 632 m² and a volume of 209 m³ at 0.3 cms.

Station 2 - Located 13.8 km above Flournoy Bridge, 1.9 km below Cold Stream, and about 3.9 km below Antelope Dam (SW $\frac{1}{4}$ of SW $\frac{1}{4}$, Section 34, T27N, R12E). The station extends 35 m from a 35.6-cm-diameter alder (RB) downstream to a 10.2-cm-diameter pine (RB). Both are marked with metal disks which can be seen from the road. The station contains riffle (64%) and shallow pool (36%) areas. It has a surface area of 287 m² and a volume of 86 m³ at 0.3 cms.

Station 3 - Located 11.5 km above Flournoy Bridge, 3.7 km above Hungry Creek, and about 5.3 km below Antelope Dam (NW $\frac{1}{4}$ of NW $\frac{1}{4}$, Section 10, T26N, R12E). The lower end of the station is about 29 m upstream from the upper end of a parking turnout. The station extends 42.7 m upstream from a 38-cm-diameter alder (RB) to a 28-cm-diameter pine (RB). Both are marked with metal disks which can be seen from the creek. The section contains a riffle area which enters a 0.9-m-deep pool followed by a riffle and a shallow pool. (Riffle area totals 39%, pool area 61%). It has a surface area of 291 m² and a volume of 117 m³ at 0.3 cms.

Station 4 - Located 10.9 km above Flournoy Bridge and about 6.8 km below Antelope Dam (NW $\frac{1}{2}$ of SW $\frac{1}{4}$, Section 10, T26N, R12E). Upper end of station is just downstream from a drainage ditch at the lower end of a parking turnout located 0.3 km above Babcock crossing. Station extends 34 m downstream to the end of a riffle just above a long, shallow pool. The station could easily be extended in length up to about 91 m. It contains riffle (54%) and shallow pool (46%) areas with a small amount of undercut bank (RB). It is not marked with metal disks. The station has a surface area of 283 m² and a volume of 57 m³ at 0.3 cms.

Station 5 - Located at unimproved campground about 5.5 km upstream from Flournoy Bridge and about 12.2 km below Antelope Dam (SW $\frac{1}{4}$ of SW $\frac{1}{4}$, Section 21, T26N, R12E). The station extends 72 m upstream from the lower end of a riffle area with several grassy hummocks (Transect 3 of the fish habitat evaluation study). Metal disks on a small willow at the lower end (LB) and a large alder snag at the upper end (RB) mark the station. The station contains a riffle and shallow run area, a shallow pool with undercut bank (RB), and a riffle area. (Riffle area is 61%, pool area 39%.) It has a surface area of 612 m² and a volume of 122 m³ at 0.3 cms.

Station 6 - Located about 0.9 km upstream from Flournoy Bridge. Drive 0.3 km east of Flournoy Bridge and take paved spur road to right. Drive 0.6 km to gate in fence on right side of road. Follow trail from gate downstream 91 m along creek where alders on RB end and a steep riffle enters a pool. The lower end of the station is at the top of the steep riffle. The station extends 39 m upstream and is marked with metal disks on 10-cm-diameter alders (RB). The disks are hard to find because there are lots of alders along the right bank. The upper half of the station is a riffle and shallow pool, followed by a rocky run and a small pool in the lower half. (Riffle area totals 46%, pool area 54%.) The station has a surface area of 241 m² and a volume of 97 m³ at 0.3 cms.

APPENDIX 2

LENGTH AND WEIGHT OF BROWN TROUT
CAUGHT IN INDIAN CREEK, SEPTEMBER 1979

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LENGTH AND WEIGHT OF BROWN TROUT CAUGHT IN INDIAN CREEK, SEPTEMBER 1979

Length (mm)	Weight (g)	Length (mm)	Weight (g)
48	1	87	6-6-7-7-7-7-7-7-7-7-8-7-7
50	1	88	7-7-7-8-6-7-7-8-8-5-7-7-
51	1		9-8-7-7
52	1-1	89	8-7-7-7-7-7-7-7-7-7-9-8-
53	1		7-8-7
54	1-1-1-1	90	9-8-8-6-8-8-7-8-7-9-8-9-
55	2		9-9-8-7-7-7-7-7-7
56	2-1-1-1-1	91	8-8-7-9-8-7-9-8-8-7-8-8-
57	2-3-2-1-3		7-7-9-7-9-9-8-8-8-7-8-8
58	1-3-2-2-3-2-2-1-3	92	7-9-8-8-9-6-8-8-9-7-8-10-
59	2-3-3-1-2-3-1		8-9-10-11-8-8-9-9-6-9
60	2-3-3-3-3-3-3-2-2-3-2	93	9-9-7-9-9-8-9-8-9-8-8-10-
61	2-3-3-3-2-2-2-3		9-8-8
62	3-3-3-3-3-3-3-3-3-2-2-3-3	94	9-9-9-8-8-7-8-8-9-9-9-9-
63	3-3-3-3-3-2-2-3-3-3-3		9-9
64	3-3-3-3-2-3-3-3-3-3-3	95	9-8-8-9-9-8-7-9-6-9-10-
65	3-3-3-3-3-3-3-3-3		9-12-9-9
66	4-3-3-5-3-2-3-3-3-3-4-3	96	9-9-9-9-7-10-9-11-11-9
67	3-3-3-3	97	9-9-9-9-8-9-10-9-11-11-
68	3-4-3-3-4-3-3-3-3-3-3-3		10-9-11-11-9
69	3-3-3-3-3-3-3-3-3	98	11-9-10-10-9-9-9
70	3-3-3-7-4-4-5-4-4	99	10-11-11-9-11-11
71	4-3-3-3-4-3-5-4	100	11-11-11-9-11-11-12
72	4-3-4-4-3-3-5-3-4-4-4	101	10-11-10-10-11-11-11-10
73	5-3-4-4-4-5-5-4-5	102	10-11-12-10
74	4-5-4-5-5-5-5-5-5-4	103	12-11-11-12-13
75	4-5-5-5-3-5-4-5-5-5-4	104	11-13-12-13
76	5-5-5-4-5-3	105	12-12
77	5-5-5-5-5-4-5-5-5-5-4-6-4	106	12-11-1-1
78	5-6-5-5-6-5-5-5-4-5-7-5-5-5-5	107	13-13
79	5-5-7-5-6-5-5-5	108	13-14-13-14-13
80	3-5-5-6-6-6-5-5-5-5-6-5-7-6-	109	13-13-10
	5-6-4-7	110	14-13
81	3-5-5-6-6-5-5-5-6-5-5-5-5-	112	14-15
	6-7-6-6	113	15
82	7-6-6-6-7-7-7-7-6-6-6-7-8-6-6	115	17
83	5-6-6-7-6-6-5-7-5-5-7-7-5-5-8	116	17-18-16
84	7-6-5-7-9-6-7-6-7-6-6-6-7-6-	125	20
	7-7-5-7-7-6	128	13
85	6-6-5-9-7-6-6-6-8-7-6-6-5-7-	135	27
	7-7-7-7-7-6-9-7-6	139	25
86	7-7-7-4-6-8-7-7-8-8-5-7-7-8-	144	44
	7-7		

<u>Length</u> <u>(mm)</u>	<u>Weight</u> <u>(g)</u>	<u>Length</u> <u>(mm)</u>	<u>Weight</u> <u>(g)</u>
145	55-36	211	110
146	35	212	120-105-115
151	40	213	110
152	42-50	216	125
153	40	217	115
155	42-42-46	218	130
156	47	219	130
158	35-38-42	220	120
159	45	221	100
160	35-52	224	120
161	45	225	115
162	70-50	226	120
163	45-53-46	227	100
164	45-55	228	170-135
165	60	235	135
166	52-53-58	247	160
167	50-50	255	190
168	51	257	210
169	54	260	205
170	45-46-54-55	262	170
171	50-62	263	190
172	50-60-58-58	264	180
173	60-60-40-46	266	190
174	55-58	268	182
175	50-55	269	230
178	65-62-59	270	190
179	60	273	270
180	70-70-70-60	275	230
181	60	279	185
182	65-60-81	280	260
184	75-75-65	288	255
185	67-70-95-60	304	310
186	70-78-76	310	300
187	55-70-70	319	340
188	70	365	520
190	75-90-80	370	680-560
191	58-85	380	530-500
192	70	398	680
194	75	414	920
195	90-90		
196	95-90-75		
197	100-80		
198	100-98-80		
200	90		
201	85		
203	95		
204	102-75		
205	110-95		
208	110		
209	105		

APPENDIX 3

LENGTH AND WEIGHT OF RAINBOW TROUT
CAUGHT IN INDIAN CREEK, SEPTEMBER 1979

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LENGTH AND WEIGHT OF RAINBOW TROUT CAUGHT IN INDIAN CREEK, SEPTEMBER 1979

<u>Length</u> <u>(mm)</u>	<u>Weight</u> <u>(g)</u>	<u>Length</u> <u>(mm)</u>	<u>Weight</u> <u>(g)</u>
52	2	161	35
55	2	162	40
58	2-2	164	50
60	3-2.5	170	46-55
62	2.5	181	55
65	3	198	75
66	3	200	105-100
69	3.5	201	90
72	4	202	80
97	9.5	204	83
101	8.5	212	124-125
106	11	215	110
125	20	220	135
128	13	221	120
132	25	230	175-170
135	27	235	145
140	25	249	175
142	25	250	180
145	36	252	170
150	38-50	255	185
155	49-24	276	220
157	40	330	400

APPENDIX 4
METRIC CONVERSION FACTORS

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METRIC CONVERSION FACTORS

<u>Quantity</u>	<u>Metric Units</u>	<u>Divide by</u>	<u>English Units</u>
Length	millimetres (mm)	25.4	inches (in)
	centimetres (cm)	2.54	inches (in)
	metres (m)	0.3048	feet (ft)
	kilometres (km)	1.6093	miles (mi)
Area	square metres (m ²)	0.0929	square feet (ft ²)
Volume	cubic metres (m ³)	0.7646	cubic yards (yd ³)
Flow	cubic metres per second (cms)	0.0283	cubic feet per second (cfs)
Biomass	grams per square metre (g/m ²)	8.92	pounds per acre (lb/acre)